SUPPORT FOR THE AMENDMENT

This Amendment amends Claims 4 and 7. Support for the amendments is found in the specification and claims as originally filed. No new matter would be introduced by entry of these amendments.

Upon entry of these amendments, Claims 1-14 will be pending in this application. Claim 1 is independent.

REQUEST FOR RECONSIDERATION

Applicants respectfully request entry of the foregoing, and reexamination and reconsideration of the application, as amended, in light of the remarks that follow.

The present invention is directed to a spring steel in which fatigue life is significantly improved by controlling the amounts of Si and Cr so that $(0.8\times[Si])+[Cr] \geq 3.0$, where [Si] is mass% Si and [Cr] is mass% Cr.

Claims 1-4, 9 and 12 are rejected under 35 U.S.C. § 103(a) over JP2002-212665 ("Nagao"). Nagao discloses a high strength and high toughness steel which is suitable as a bar steel stock for a bolt, a spring or the like. Nagao at English-language abstract.

Claims 1-14 are rejected under 35 U.S.C. § 103(a) over U.S. Patent No. 6,338,763 ("Hashimura"). Hashimura discloses steel wire for high-strength springs. Hashimura at title.

Claims 1-14 are provisionally rejected on the ground of nonstatutory obviousness-type double patenting over claims 1-2 of co-pending Application No. 10/549,753.

Any *prima facie* case of obviousness or obviousness-type double patenting based on the cited prior art is rebutted by the significant increase in fatigue life that is observed in the spring steel of independent Claim 1 when the Si content and the Cr content satisfy the formula "$(0.8\times[Si])+[Cr] \geq 3.0$". This is demonstrated in the attached Declaration Under 37 C.F.R. 1.132, which is drawn from the specification at Table 1, reproduced below.

Table 1

Examples	Chemical compositions (% by mass)*										Grain size number	Calculated 0.8Si+Cr	Fatigue life ($\times 10^6$ cycles)	Initiation of fracture	Residual shear strain (%)
	C	Si	Mn	P	S	Ni	Cr	V	Mo	Al					
1	0.75	2.00	0.75	0.010	0.009	0.00	1.50	0.21	0.00	0.003	10.5	3.1	20	-	0.041
2	0.60	1.95	0.69	0.008	0.007	0.00	1.24	0.32	0.00	0.002	10.5	2.8	20	-	0.037
3	0.59	1.44	0.68	0.008	0.011	0.00	3.10	0.18	0.00	0.002	11.0	4.3	20	-	0.029
4	0.53	2.07	1.22	0.005	0.006	0.00	1.81	0.11	0.00	0.002	11.0	3.5	20	-	0.045
5	0.72	1.85	0.85	0.006	0.011	0.18	1.69	0.24	0.00	0.003	10.5	3.2	20	-	0.025
6	0.52	2.26	0.94	0.008	0.005	0.00	2.05	0.23	0.28	0.035	10.0	3.9	20	-	0.038
7	0.61	2.00	0.85	0.013	0.005	0.25	1.05	0.11	0.00	0.001	10.5	2.7	20	-	0.047
8	0.78	1.24	0.67	0.007	0.008	0.00	2.01	0.16	0.00	0.003	11.0	3.0	20	-	0.033
9	0.63	2.43	0.71	0.009	0.007	0.43	1.12	0.12	0.00	0.003	10.5	3.1	20	-	0.041
10	0.61	2.05	0.32	0.008	0.010	0.00	1.68	0.27	0.00	0.002	12.0	3.3	20	-	0.029
11	0.68	1.37	0.47	0.015	0.012	0.00	1.51	0.17	0.00	0.003	11.5	2.6	20	-	0.039
12	0.55	1.45	0.70	0.010	0.009	0.00	0.70	0.00	0.00	0.003	9.5	1.9	5.0	Surface	0.075
13	0.63	1.40	0.60	0.007	0.012	0.00	0.65	0.11	0.00	0.003	10.0	1.8	7.8	Surface	0.064
14	0.60	1.50	0.70	0.011	0.010	0.25	0.90	0.06	0.00	0.041	10.0	2.1	7.0	Oxide inclusions	0.065
15	0.59	1.29	0.75	0.008	0.014	0.00	1.51	0.00	0.09	0.002	10.5	2.5	10.3	Surface	0.059
16	0.72	0.80	0.78	0.006	0.009	0.00	1.49	0.05	0.15	0.002	11.0	2.1	4.3	Surface	0.084
17	0.65	2.01	0.90	0.005	0.005	0.00	0.80	0.15	0.00	0.001	10.0	2.4	1.7	Oxide inclusions	0.049
18	0.59	1.51	0.83	0.007	0.012	0.00	1.31	0.23	0.00	0.003	10.5	2.5	8.3	Oxide inclusions	0.055
19	0.68	1.25	1.22	0.011	0.009	0.00	1.16	0.35	0.00	0.003	10.5	2.2	12.7	Surface	0.102

* The balance is Fe and inevitable impurites.

In Table 1, when the steel wire was not broken the fatigue life test was discontinued after 20×10^6 cycles. Specification at page 8, lines 8-9.

In contrast, the Rule 132 Declaration shows in Table 1' and FIG. A the fatigue lives until breakage. FIG. A is reproduced below.

FIG. A

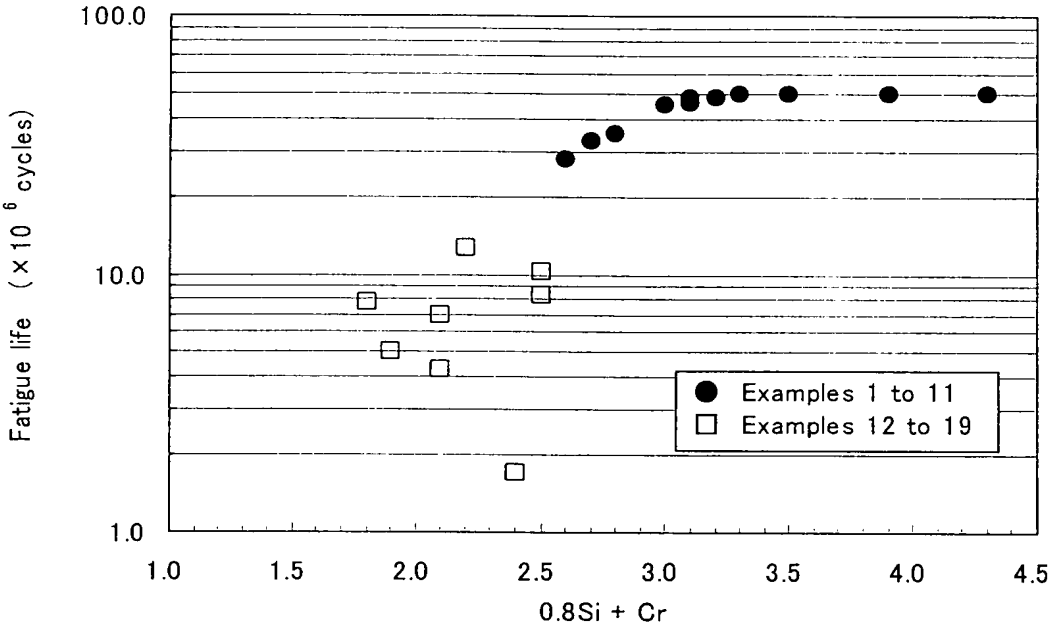

FIG. A shows that fatigue life is significantly improved when in accordance with independent Claim 1 "$(0.8\times[Si])+[Cr] \geq 3.0$".

In contrast to the present invention, Nagao is silent about fatigue and is silent about fatigue life.

Hashimura discloses a high strength of 1960 MPa or greater is indispensable for improving spring fatigue strength and permanent fatigue resistance. Hashimura at column 2, lines 3-5.

The term "fatigue strength" can be defined as "the maximum stress that can be sustained for a specified number of cycles without failure, the stress being completely

reversed within each cycle unless otherwise stated". Metals Handbook, Desk Edition, page 1•16 (copy attached).

In contrast, the term "fatigue life" can be defined as "the number of cycles of stress that can be sustained prior to failure under a stated test condition". Id.

Fatigue strength does not predict fatigue life.

> In practice, except for a few relatively brittle materials, prediction of the fatigue life of a material is complicated because fatigue life is very sensitive to small changes in loading conditions, local stresses and local characteristics of the material. Because it is difficult to account for these minor changes in either the dynamic stress-prediction techniques or in fatigue-failure criteria, there is a large uncertainty inherent in analytical prediction of fatigue life. Id., at 32•14.

Thus, Hashimura's disclosure of fatigue strength does not suggest the improved fatigue life achieved by the present invention.

Claims 1-2 of co-pending Application No. 10/549,753 are directed to steel wire for a high-strength spring having superior workability, but are silent about fatigue and about fatigue life.

Because the cited prior art fails to suggest the significant improvement in fatigue life that is achieved in accordance with independent Claim 1 when "$(0.8\times[Si])+[Cr] \geq 3.0$", any *prima facie* case of obviousness or obviousness-type double patenting based on the cited prior art is rebutted.

As a result, the rejections under 35 U.S.C. § 103(a) and the provisional rejection for obviousness-type double patenting should be withdrawn.

Claim 7 is objected to. To obviate the objection, the old range of "1.3% to 4.0%" is deleted from Claim 7.

In view of the foregoing amendments and remarks, Applicants respectfully submit that the application is in condition for allowance. Applicants respectfully request favorable consideration and prompt allowance of the application.

Should the Examiner believe that anything further is necessary in order to place the application in even better condition for allowance, the Examiner is invited to contact Applicants' undersigned attorney at the telephone number listed below.

Respectfully submitted,

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Attached:

Declaration Under 37 C.F.R. 1.132
Metals Handbook, Desk Edition, pages 1•16; 32•14